

REMARKS

Claims 17, 19, and 20 have been amended. Claims 1 and 3-28 are pending in the case. Entrance of the amendments and further examination and reconsideration of pending claims 1 and 3-28 are respectfully requested.

Section 103 Rejections

Claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,701,004 to Shykind et al. (hereinafter “Shykind”) in view of U.S. Patent No. 5,932,377 to Ferguson et al. (hereinafter “Ferguson”). Claims 20-21 and 23-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and further in view of U.S. Patent No. 6,665,065 to Phan et al. (hereinafter “Phan”) and “Critical Area Extraction for Soft Fault Estimation” by Allan et al. (hereinafter “Allan”). Claims 1, 3-7, 9, 10, 15, 18, and 19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and further in view of U.S. Patent No. 5,046,109 to Fujimori et al. (hereinafter “Fujimori”). Claim 22 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson, Phan and Allan, and further in view of Fujimori. Claim 8 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and Fujimori and further in view of U.S. Patent No. 7,133,548 to Kenan et al. (hereinafter “Kenan”). Claim 11 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and Fujimori and further in view of U.S. Patent No. 5,444,480 to Sumita (hereinafter “Sumita”). Claims 12 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and Fujimori and further in view of U.S. Patent Application Publication No. 2002/0181756 to Shibuya et al. (hereinafter “Shibuya”). Claims 14, 16, 27, and 28 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and Fujimori and further in view of U.S. Patent No. 6,091,846 to Lin et al. (hereinafter “Lin”). As will be set forth in more detail below, the § 103(a) rejections of claims 1 and 3-28 are respectfully traversed.

To establish *prima facie* obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP 2143.03. Obviousness cannot be established by combining or modifying the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion or incentive to do so. *In re Bond*, 910 F.2d 81, 834, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990). The cited art does not teach or suggest all limitations of the currently pending claims, some distinctive limitations of which are set forth in more detail below.

The cited art does not teach or suggest determining a presence of an anomaly in a design pattern of a reticle by comparing at least one pair of aerial images corresponding to at least two different values of a member of a set of lithographic variables for which the aerial images are acquired, one value of which represents a reference member value.

Independent claim 1 recites:

A method, comprising: acquiring aerial images of a reticle containing a design pattern, wherein the aerial images are acquired for different values of a member of a set of lithographic variables, and wherein one of the different values represents a reference member value; and determining a presence of an anomaly in the design pattern by comparing at least one pair of the aerial images corresponding to at least two of the different values, wherein one of the at least two of the different values represents the reference member value.

The Office Action states:

Shykind et al (as modified by Ferguson et al) does not disclose expressly that one of the different values represents a reference member value. Fujimori et al discloses the use of reference data, DR, the reference member value that is used to compare to another input data (col. 3, lines 52-65), which is paralleled to the other value of Shykind et al by use of comparison between two pieces of data. (Office Action -- page 14).

Applicants respectfully traverse this assertion. In particular, Fujimori states that "The inspection circuit 20 is adapted for comparing the image data DI and the reference data DR...If there is any

difference between both data indicative of any defect in the real pattern, the inspection circuit 20 delivers defect data DD to the computer 22." (Fujimori -- col. 3, lines 41-47). Fujimori also states that "Accordingly, a primary object of the present invention is to provide a pattern inspection apparatus which is capable of performing a high degree of precision of defect detection by comparing the real pattern with the design data on as many characteristic points as possible." (Fujimori -- col. 1, lines 57-61). Therefore, Fujimori discloses comparing image data for an object to reference data to determine if there are defects on the object. In addition, Fujimori discloses that the reference data is design data. However, design data, the reference data of Fujimori, is not a reference member value of a member of a set of lithographic variables as presently claimed. For instance, design data is not a value of illumination focus, exposure, degree of partial coherence, numerical aperture, or any other lithographic variable. In addition, Fujimori does not teach or suggest that the design data is a value of illumination focus, exposure, degree of partial coherence, numerical aperture, or any other lithographic variable. Therefore, contrary to the assertions in the Office Action, the reference data, DR, of Fujimori is not a reference member value as presently claimed. As such, Fujimori cannot be combined with Shykind and Ferguson as contended in the Office Action to overcome deficiencies in the teachings of Shykind and Ferguson.

The Office Action also states that "Fujimori discloses that reference data is used to compare to input data, as disclosed in the previous office action's rejection for claim 2, showing that it is possible to have a reference value that is compared." (Office Action -- pages 2-3). However, as presently claimed, a reference member value is not compared to anything. Instead, as presently claimed, an aerial image acquired at a reference member value of a member of a set of lithographic variables is compared to another aerial image acquired at a different value of the member of the set of lithographic variables. However, Shykind, Ferguson, and Fujimori do not teach or suggest acquiring an aerial image at a reference member value of a member of a set of lithographic variables. Therefore, Shykind, Ferguson, and Fujimori cannot teach or suggest comparing such an aerial image to another aerial image acquired at a different value of the member of the set of the lithographic variables. In addition, although Fujimori discloses

comparing design data (reference data) to image data to detect defects on a reticle, Fujimori does not teach or suggest that the design data (reference data) is acquired at or corresponds to a reference member value of a member of a set of lithographic variables. Therefore, the reference data of Fujimori is not a “reference” as presently claimed. Consequently, the combination of Shykind, Ferguson, and Fujimori does not teach or suggest determining a presence of an anomaly in a design pattern of a reticle by comparing at least one pair of aerial images corresponding to at least two different values of a member of a set of lithographic variables for which the aerial images are acquired, one value of which represents a reference member value, as recited in claim 1.

Furthermore, none of the other cited art (i.e., Phan, Allan, Kenan, Sumita, Shibuya, and Lin) teaches or suggests determining a presence of an anomaly in a design pattern of a reticle by comparing at least one pair of aerial images corresponding to at least two different values of a member of a set of lithographic variables for which the aerial images are acquired, one value of which represents a reference member value, as recited in claim 1. Therefore, none of the cited art, individually or in any combination thereof, teaches or suggests all limitations of claim 1.

The cited art does not teach or suggest comparing aerial images to find areas on a reticle in which anomalies in a design pattern contained by the reticle are located and determining which of the areas on the reticle where a lithography process using the reticle is most susceptible to failure. Amended independent claim 17 recites, in part: “acquiring aerial images of a reticle containing a design pattern,...comparing at least one pair of the aerial images...to find areas on the reticle in which anomalies in the design pattern are located; and determining which of the areas on the reticle where a lithography process using the reticle is most susceptible to failure based on results of said comparing.” Support for the amendments to claim 17 can be found in the Specification, for example, on page 13, line 10 to page 14, line 17.

Shykind states that “The comparison circuit 210 takes the patterns printed on several sets of dice with different conditions and compares them. The identification mechanism 212

identifies features that display different patterns for same area under different process conditions. The sorter 214 then sorts the identified features to detect and flag mask defects.” (Shykind -- col. 2, lines 32-37). Therefore, Shykind discloses detecting and flagging mask defects. Shykind also states that “The different conditions, such as a length of exposure time and an optical focus condition, are configured to highlight and detect defect areas.” (Shykind -- col. 1, lines 41-43). Therefore, Shykind discloses detecting defect areas on a mask. However, different defects on a mask in different areas on the mask will cause a lithography process using the mask to have different susceptibilities to failure. In addition, although Shykind discloses detecting defect areas on a mask, Shykind does not teach or suggest determining which of the defect areas will cause a lithography process using the mask to be most susceptible to failure. Therefore, Shykind does not teach or suggest determining which areas on a reticle where a lithography process using the reticle is most susceptible to failure. As such, Shykind does not teach or suggest comparing aerial images to find areas on a reticle in which anomalies in a design pattern contained by the reticle are located and determining which of the areas on the reticle where a lithography process using the reticle is most susceptible to failure, as recited in claim 17.

Ferguson discloses an exact transmission balanced alternating phase-shifting mask for photolithography. Ferguson states that “Application of feedback during the fabrication process, which includes techniques such as direct aerial image measurements with optical parameters to emulate the photolithographic stepper, provide additional and precise control on the edge location of the etched-quartz trench.” (Ferguson -- col. 5, lines 3-8). However, Ferguson does not teach or suggest comparing aerial images to find areas on a reticle in which anomalies in a design pattern contained by the reticle are located and determining which of the areas on the reticle where a lithography process using the reticle is most susceptible to failure, as recited in claim 17. Therefore, Ferguson cannot be combined with Shykind to overcome deficiencies contained therein.

Furthermore, none of the other cited art (i.e., Phan, Allan, Fujimori, Kenan, Sumita, Shibuya, and Lee) teaches or suggests comparing aerial images to find areas on a reticle in which

anomalies in a design pattern contained by the reticle are located and determining which of the areas on the reticle where a lithography process using the reticle is most susceptible to failure, as recited in claim 17. Therefore, none of the cited art, individually or in any combination thereof, teaches or suggests all limitations of claim 17.

The cited art does not teach or suggest determining a presence of transient repeating defects, which are defects that will print under only a portion of different values of a member of a set of lithographic variables, on a reticle. Amended independent claim 20 recites, in part: “acquiring aerial images of the reticle for different values of a member of a set of lithographic variables; and determining a presence of transient repeating defects on the reticle...wherein the transient repeating defects are defects that will print under only a portion of the different values.” Support for the amendments to claim 20 can be found in the Specification, for example, on page 3, lines 8-10 and page 4, lines 23-24.

The Office Action states that “Shykind et al (as modified by Ferguson et al) does not disclose expressly...determining a presence of transient repeating defects on the reticle...Phan et al discloses finding/ determining the presence of hard and soft faults in a reticle, which are equivalent to transient and non-transient defects (col. 4, lines 14-16).” (Office Action -- page 10). Applicants respectfully traverse this assertion. For example, Phan states that “the inspection system 16 includes both pattern inspection to locate hard pattern defects as well as particulate inspection to expose soft contaminant based defects.” (Phan -- col. 4, lines 14-17). However, Phan does not teach or suggest that the hard and/or soft defects will print under only a portion of different values of a member of a set of lithographic variables. Therefore, the hard and soft defects detected by the system of Phan are not equivalent to transient repeating defects as presently claimed. In addition, Phan does not teach or suggest determining if the hard and/or soft defects will print under only a portion of different values of a member of a set of lithographic variables. As such, Phan does not teach or suggest determining a presence of defects that will print under only a portion of different values of a member of a set of lithographic variables. Therefore, Phan does not teach or suggest determining a presence of transient repeating defects,

which are defects that will print under only a portion of different values of a member of a set of lithographic variables, on a reticle, as recited in claim 20, and cannot be combined with Shykind and Ferguson as suggested in the Office Action to overcome deficiencies in the teachings contained therein.

Allan cannot be combined with Shykind, Ferguson, and Phan to overcome deficiencies in the teachings contained therein. For example, Allan discloses detecting hard and soft faults in a circuit. However, the hard and soft faults disclosed by Allan are not equivalent to transient repeating defects as presently claimed. In particular, Allan states:

Extra material defects cause circuit faults which can be classified as one of two types [2]: Hard Faults: These are faults which cause a short between two separate electrical nodes as shown in Fig. 1(a). These faults can be modeled electrically by a resistor connecting adjacent tracks. Soft Faults: These are generated by defects that do not connect separate electrical nodes but reduce the distance between them as shown in Fig. 1(b). The distance is reduced to such an extent that the defect can be modeled as a leaky capacitor. (Allan -- page 146).

Therefore, Allan discloses that hard and soft faults are both caused by extra material defects on a wafer. However, Allan does not teach or suggest that such hard and soft faults are or are caused by transient repeating defects. For example, Allan does not teach or suggest that the hard and soft faults will print under only a portion of different values of a member of a set of lithographic variables. In addition, Allan does not teach or suggest that the hard and soft faults are caused by defects on a reticle that will print under only a portion of conditions. As such, Allan does not teach or suggest determining a presence of transient repeating defects, which are defects that will print under only a portion of different values of a member of a set of lithographic variables, on a reticle, as recited in claim 20, and cannot be combined with Shykind, Ferguson, and Phan to overcome deficiencies contained therein.

Furthermore, none of the other cited art (i.e., Fujimori, Kenan, Sumita, Shibuya, and Lin) teaches or suggests determining a presence of transient repeating defects, which are defects that

will print under only a portion of different values of a member of a set of lithographic variables, on a reticle, as recited in claim 20. Therefore, none of the cited art, individually or in any combination thereof, teaches or suggests all limitations of claim 20.

For at least the reasons stated above, independent claims 1, 17, and 20, as well as claims dependent therefrom, are patentably distinct over the cited art. Accordingly, removal of the § 103 rejections of claims 1 and 3-28 is respectfully requested.

CONCLUSION

This response constitutes a complete response to all issues raised in the Office Action mailed September 28, 2007. In view of the amendments and remarks presented herein, Applicants assert that pending claims 1 and 3-28 are in condition for allowance. If the Examiner has any questions, comments, or suggestions, the undersigned earnestly requests a telephone conference.

The Commissioner is authorized to charge any fees, which may be required, or credit any overpayment, to deposit account number 02-0393.

Respectfully submitted,

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